SECTION 34 11 27

BALLASTED TRACK

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Subballast.

B. Ballast.

C. Tie placement.

D. Rail installation.

E. Tamping.

F. Surfacing and aligning track.

G. Tire Derived Aggregate (TDA).

1.02 RELATED REQUIREMENTS

A. Refer to Section 34 05 17, Common Work results for Trackway and related requirements.

B. Refer to Section 34 11 93, Track Appurtenances and Accessories, for procurement and related requirements for rail fastener materials.

C. Refer to Section 34 11 31, Concrete Ties, for procurement and related requirements for concrete tie materials.

D. Refer to Section 34 11 25, Running Rail – for related requirements.

1.03 MEASUREMENT AND PAYMENT

A. Ballasted track will not be measured separately for payment. All costs in connection therewith will be considered as included in the applicable Contract lump sum price or the Contract unit price per linear foot for trackwork of the different types indicated in the Bid Schedule of the Bid Form.

1.04 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering

B. American Society for Testing and Materials (ASTM):

1.	ASTM C29/C29M	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
2.	ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
3.	ASTM C117	Standard Test Method for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
4.	ASTM C127	Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
5.	ASTM C136/C136M	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
6.	ASTM C142/C142M	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
7.	ASTM C535	Standard Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
8.	ASTM C702/C702M	Standard Practice for Reducing Field Samples of Aggregate to Testing Size
9.	ASTM D75/D75M	Standard Practice for Sampling Aggregates
10.	ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
11.	ASTM D6270	Standard Practice for use of Scrap Tires in Civil Engineering Applications
12.	ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
13.	ASTM D3786/ D3786M	Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
14.	ASTM D4533/ D4533M	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
15.	ASTM D4632/ D4632M	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
16.	ASTM D4833/ D4833M	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products

17. ASTM D4491/ D4491M — Standard Test Methods for Water Permeability of Geotextiles by Permittivity

18. ASTM D4751 — Standard Test Methods for Water for Determining Apparent Opening Size of a Geotextile

C. State of California, Department of Transportation (Caltrans), Standard Specifications:

1. Section 10-6 — Watering

2. Section 26 — Aggregate Bases

D. State of California, Department of Transportation (Caltrans), Standard Test Methods:

1. Calif. Test 201 — Method of Test for Soil and Aggregate Sample Preparation

2. Calif. Test 202 — Method of Test for Sieve Analysis of Fine and Coarse Aggregates

3. Calif. Test 205 — Method of Test for Determining Percentage of Crushed Particles

4. Calif. Test 216 — Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates

5. Calif. Test 217 — Method of Test for Sand Equivalent

6. Calif. Test 229 — Method of Test for Durability Index

7. Calif. Test 301 — Method of Test for determining the Resistance “R” Value of Treated and Untreated Bases, Subbases and Basement Soils by the Stabilometer

1.05 SUBMITTALS

A. Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Submit ballast shipping, handling, and placing plan.

C. Provide additional submittals as required herein.

1.06 QUALITY ASSURANCE

A. Track sub grade is the top of subballast. The track sub grade may vary from the design elevations and the line cross sections within the range of plus or minus one half inch.

B. Prior to commencement of trackwork construction, the Contractor will determine the condition of the trackbed for all track types as to line, grade, and cross section, and compaction.

1. Sub grade settlement discovered at this time shall only be corrected by repairing the sub grade as provided herein.

2. Subballast shall be placed and compacted in accordance with the requirements provided herein.

3. Prior to the placement of ballast or other construction on the sub grade the Contractor shall submit to the Engineer a report confirming the readiness of the sub grade.

C. Except for the modifications, amplifications, deletions, and additions indicated herein, construct ballasted track in accordance with the requirements of the AREMA Manual.

D. Ballast is subject to inspection and testing by the Engineer at any time between quarry production and acceptance of track. Ballast that does not conform to these Specifications will be rejected, and the Engineer will notify the Contractor to stop further ballast operations until the defective material has been removed and replaced without additional cost to the District.

1.07 BALLAST TESTING AGENCY

A. Engage an independent testing agency to test the ballast at the quarry source to ensure that the classification, quality, and grading of the ballast at the time of shipment conforms to the specified requirements herein.

1.08 BALLAST SHIPPING AND HANDLING

A. Load only into rail cars or trucks that are in good order, tight enough to prevent leakage and waste of material, and clean and free from rubbish and any substance that may foul the ballast.

B. Handling

1. Handle prepared ballast at the producing plant, during shipment, and at the site so that it is kept clean and free from segregation. Ballast containing any substance that may foul or damage the ballast will be rejected.

2. Do not make repeated passes of equipment over the same level in the stockpile area.

3. Prepare a plan for the proposed transporting from the source, handling, stockpiling, and final distribution and placing of ballast in track; including the location of all stockpiles and the identification, quantity, and condition of all equipment. Submit the plan for the Engineer’s approval prior to shipment.

PART 2 – PRODUCTS

2.01 DISTRICT-FURNISHED MATERIALS

A. Refer to Section 01 64 13, District-Furnished Materials and Equipment, of the Contract Specifications for description and quantity of District-furnished materials.

2.02 CONTRACTOR-FURNISHED MATERIALS

A. All products, tools, materials, equipment and labor required to complete all aspects of the work shall be furnished by the Contractor.

2.03 SUBBALLAST MATERIAL

A. Subballast shall comply with Caltrans Standard Specifications, Section 26, Class 2 Aggregate Base, three-fourths inch maximum grading, with the following additional requirements: Aggregate for subballast shall consist of crushed stone or gravel (reclaimed material will not be allowed), and shall consist of material of which at least 25 percent by weight shall be crushed particles as determined by California Test Method No. 205. Composition of subballast, in percentages by weight, shall conform to the grading shown in Table 1, determined in accordance with California Test Method No. 202.

Table 1 - Percentage Passing Sieves

Sieve Sizes	Maximum
2-inch	0
1-1/2 inch	100
3/4-inch	90-100
No. 4	35-55
No. 30	10-30
No. 200	2-9

B. Subballast shall conform to the additional requirements shown in Table 2.

Table 2 - Additional Requirements

Tests	California Test Method No.	Requirements
Resistance (R-Value)	301	78 min.
Sand Equivalent	217	22 min.
Durability Index	229	35 min.

C. At the time subballast is placed, it shall be free from organic matter and other deleterious substances.

2.04 BALLAST QUALITY REQUIREMENTS

A. Ballast shall be newly acquired from the supplier. Under no circumstances shall used ballast or ballast removed from existing track be used.

B. The amount of deleterious substances present in the prepared ballast shall not exceed the limits shown in Table 3, when performing the following specified tests.

C. Particles having a width to thickness or length to width ratio greater than three shall not exceed five percent by weight of the total as determined by ASTM D4791.

D. The percentage of wear, when tested in the Los Angeles abrasion machine in accordance with ASTM C535, shall not exceed the percentages shown in Table 4.

E. The soundness of the prepared ballast shall be such that, when tested in the sodium sulphate soundness test in accordance with ASTM C88, the weighted average loss shall not exceed five percent after five cycles of the test.

F. Water absorption shall not exceed one percent when tested in accordance with ASTM C127.

G. Determine ballast weight per cubic foot in accordance with ASTM C29/C29M.

H. Ballast samples shall be obtained in accordance with ASTM D75/D75M. Test samples shall be reduced from field samples to testing size in accordance with ASTM C702/C702M.

Table 3 - Deleterious Substances

Test For	Percent By Weight	Test Method
Material Finer than No. 200 Sieve	1	ASTM C117
Clay Lumps and Friable Particles	0.5	ASTM C142/C142M

Table 4 - Percentage Of Wear

TYPE	Percent
Granite	35
Traprock	25
Quartzite	30

2.05 BALLAST GRADING REQUIREMENTS

A. Provide ballast gradation shown in Table 5.

B. Determine the grading of the ballast in accordance with ASTM C136/C136M.

C. Ballast samples shall be obtained in accordance with ASTM D75/D75M. Test samples shall be reduced from field samples to testing size in accordance with ASTM C702/C702M.

Table 5 - Ballast Gradation

Size of Square Sieve Opening	Percent Passing By Weight
2 inches	100
1-1/2 inches	90 to 100
1 inches	25 to 60
3/4 inch	0 to 10

2.06 TIRE DERIVED AGGREGATE (TIRE SHREDS)

A. General: The material shall be made from scrap tires which shall be shredded into the sizes specified herein. Tire shreds shall be free of contaminants such as oil and grease that could leach into the groundwater or create a fire hazard. Tire shreds shall not contain remains of tires that have been subject to a fire. Tire shreds shall have not more than one percent, by weight, of metal fragments which are embedded fully or partially in the rubber. Metal fragments that are partially embedded in rubber shall protrude not more than one-inch from the cut edge of the tire shred on 75 percent of the pieces, by weight, and not more than two inch on 100 percent of the pieces.

B. Type A Tire Shreds: Type A tire shreds shall have a maximum dimension, measured in any direction, of eight inches. Type A tire shreds shall have 100 percent, by weight, passing the four-inch square mesh sieve, a minimum of 50 percent passing the two-inch square mesh sieve, and a maximum of five percent passing the number four sieve.

2.07 GEOTEXTILE FABRIC

A. The geotextile fabric shall have property values expressed in “minimum” or “minimum average roll” values that meet or exceed the values listed below, as determined by the test methods specified below. All Mechanical property values expressed as “average” or “typical” shall exceed the minimum permissible values specified below by not less than 25 percent.

Geotextile Mechanical Property Value	Test Method	Minimum Permissible
Mullen Burst Strength	ASTM D3786/D3786M	290 psi
Trapeziodal Tear Strength	ASTM D4533/D4533M	50 lb.
Grab Tensile Strength (both directions)	ASTM D4632/D4632M	180 lb.
Grab Elongation	ASTM D4632/D4632M	15 percent
Puncture Resistance	ASTM D4833/D4633M	50 lb.
Permeability	ASTM D4491/D4491M	0.001 cm/sec maximum
Apparent Opening Size (AOS)	ASTM D4751	U.S. Std. Sieve number(s) between No. 20 & No. 100

2.08 SOURCE QUALITY CONTROL

A. Subballast material shall be sampled and tested in accordance with the California Test Methods specified herein, to determine compliance with specified requirements. Samples shall be taken from material as delivered to the site, and shall be prepared in accordance with California Test Method No. 201.

B. The Contractor shall establish the ballast quality, grading, and washing requirements at the time of shipment to ensure that the ballast conforms to the requirements herein when installed in trackwork.

C. Tests of ballast at the quarry source conducted by the independent testing agency shall include the following:

1. A test sample not less than 150 pounds shall be taken from a quarry test run of prepared ballast in accordance with the requirements of ASTM D75/D75M.

2. Perform the tests and inspections in accordance with Articles 2.04 and 2.05 herein on the ballast samples.

D. Engineer's Approval

1. Obtain Engineer's approval of ballast material prior to commencing delivery of the ballast to the site.

2. If, during ballast installation, the source of ballast changes, the Contractor shall perform tests at the new production site in accordance with these Specifications. The ballast shall have the same classification, quality, and grading as the former ballast used. Delivery to the site shall not commence until the Engineer has approved the new ballast source.

PART 3 – EXECUTION

3.01 INSPECTION

A. The Contractor shall call for an inspection, at least one week in advance, by the Engineer and obtain approval of the prepared sub grade or sub base before proceeding with the subballast course.

B. The sub grade or sub base to receive subballast, immediately prior to spreading, shall conform to the compaction and elevation tolerances indicated for the material involved and shall be free of standing water and loose or extraneous material.

3.02 SUBBALLAST INSTALLATION

A. Subballast course shall be applied over the prepared sub grade or sub base and compacted in accordance with Section 26 of the Caltrans Standard Specifications.

B. Subballast course shall be minimum uniform thickness after compaction of dimensions indicated. Where not indicated, compacted thickness shall be six inches.

C. All compaction expressed in percentages in this Section refers to the maximum dry density of the material as determined by California Test Method No. 216.

D. Aggregate for subballast shall be delivered as uniform mixture of fine and coarse aggregate and shall be spread in layers without segregation.

E. Subballast material shall be free of pockets of large and fine material. Segregated materials shall be remixed until uniform.

F. Subballast material shall be moisture-conditioned to near optimum moisture content in accordance with the applicable requirements of Section 10-6 of the Caltrans Standard Specifications.

G. Subballast six inches and less in thickness may be spread and compacted in one layer. For thickness greater than six inches, the subballast shall be spread and compacted in two or more layers of uniform thickness not greater than six inches each.

H. Relative compaction of each layer of compacted subballast material shall be not less than 95 percent as determined by California Test Method No. 216.

I. Thickness of finished subballast course shall not vary more than one inch from the indicated thickness at any point. Subballast that does not conform to this requirement shall be reshaped or reworked, watered, and re-compacted to achieve compliance with specified requirements.

J. The surface of the finished subballast course at any point shall not vary more than one inch above or below the indicated grade.

3.03 DOCUMENTATION AND PROTECTION OF FACILITIES IN TRACKBED

A. Survey and document the condition of facilities in the trackbed, including buried conduits in the track bed, conduit stub-ups, precast concrete trenches, sub drains and filter beds, cleanouts, ballast screens, and manholes. Incorporate the information in a report and submit to the Engineer prior to starting construction work and the operation of heavy equipment and vehicles on the trackbed.

B. Protect all facilities in, under, or on the trackbed during track construction. Repair all damage to the facilities, at no additional cost to the District, which was caused by the Contractor's operations, and which was not a pre-existing condition as indicated in the Contractor's survey report.

3.04 PRELIMINARY BALLAST LAYER

A. Preparation: Correct all rutting and other damage to the sub grade prior to placing ballast.

B. Installation: A layer of ballast six to eight inches deep shall be placed on the prepared sub-grade or subballast for all main tracks, ready for compacting without further shaping. The ballast shall be compacted with not less than three passes of a vibratory roller of gross weight not less than 5,000 pounds, a drum not less than 58 inches wide and not less than 42 inches in diameter. The vibration frequency shall be between 1,100 and 2,000 vibrations per minute and shall impart a dynamic impact of not less than nine tons. Avoid damage to existing facilities including sub-drains, stub-ups, conduits, and other structures.

C. Ballast Deck Bridges: Install a preliminary ballast layer on main track ballast deck bridges directly over the waterproofing protection boards, taking care not to damage the protection boards and the perforated deck drains.

D. Ballast Finish: The top of the preliminary ballast layer shall be a level, flat plane, uniformly compacted prior to cross tie distribution.

3.05 CROSS TIE DISTRIBUTION

A. Position all ties with a jig in final location and normal to the centerline of track.

B. Position all ties within plus or minus one inch of required spacing as indicated on Contract Drawing, without accumulation.

C. Placing Ties

1. Place ties so the bottom of each tie will bear fully on initial layer of ballast.

2. Alternate the ends of cross ties with contact rail bracket anchor inserts, except at special locations as indicated on the Contract Drawings.

3.06 RAIL INSTALLATION

A. Lay, join and anchor CWR and jointed rail as provided herein.

3.07 TAMPER-LINER MACHINE

A. Provide a production type tamper-liner capable of lifting, lining, and surfacing track and turnouts within the specified track tolerances and with the specified ballast. The machine shall be capable of external control of both line and grade. The machine shall be capable of external control of alignment utilizing a laser guidance system.

B. Each lift of ballast shall be thoroughly tamped, with a squeeze type vibrating tamping machine, from a point 18 inches inside each rail on both sides of the tie to the end of the ties. The ballast shall be packed tight under and around the tie for the length specified. Tamping shall not be permitted at the center of the tie between the above stated limits. Both ends of the tie shall be tamped simultaneously, and tamping inside and outside of the rail shall be performed at the same time.

C. Lift both rails together as uniformly as possible.

D. Operate tamper machine in accordance with the machine manufacturer's printed instructions. Provide a copy of the instructions to the Engineer.

E. Do not operate the machine on tangent tracks unless the laser guidance system is utilized.

F. Tamper operation shall not damage ties. All ties damaged in any fashion by tamping of ballast shall be replaced. Patching or other repairs of ties will not be accepted.

3.08 PRELIMINARY SURFACING AND ALIGNING

A. General

1. Surfacing and/or aligning of the track shall not be performed when the rail temperature is higher than 100 degrees Fahrenheit.

2. Track surfacing and aligning shall be performed by methods which will prevent bending of the rail, straining of the rail joints, and damage to the ties or rail fastening assemblies.

3. All switch and switch machine rods shall be removed prior to tamping. The rods shall be replaced and the switch readjusted, as required herein, when tamping is completed.

B. Control and check the alignment of the track on the preliminary ballast with the necessary alignment and grade stakes.

C. Ballast:

1. Handle, transport, and place ballast to avoid segregation and generation of fines.

2. Place and maintain sufficient ballast in the cribs and shoulders to anchor the cross ties and prevent movement or buckling of the track due to temperature changes or equipment operation.

D. Lifting:

1. Track shall be lifted so that it will be necessary to give it a finishing lift of not less than one inch nor more than two inches to bring it to final grade. Alignment shall be maintained during the lifting operation.

2. Ties that have been pulled loose shall be replaced to proper position, and shall have a bearing against the rail, and shall be secured to the rail.

3. The amount of each lift, including that required for superelevation, shall not exceed four inches nor endanger the horizontal or vertical stability of the track.

3.09 FINAL SURFACING AND ALIGNING

A. A finishing lift and alignment shall be made to bring tracks to the true line and grade within the specified tolerances after completion of the preliminary surfacing and aligning.

3.10 BALLAST REGULATION

A. After final surfacing and aligning is completed, ballast shall be dressed as indicated. The portion of the sub grade outside of the ballast shall be trimmed an even surface sloped for drainage.

3.11 BALLAST CONSOLIDATION

A. Compact ballast with rail mounted equipment specifically designed to dynamically stabilize the track structure through the rail.

B. Dynamic track stabilizer capable of applying stabilizing forces into the track structure at a continuous speed of one half miles per hour. The equipment shall have an operational measuring system that provides for accurate measurement and control of stabilization.

C. The ballast shall be stabilized twice. Once prior to final raise and once after final raise and alignment to finish grade.

3.12 CONTACT RAIL INSTALLATION

A. Contact rail insulator brackets shall not be bolted to the crossties until completion of ballast dressing and consolidation.

B. Ballast shall conform to full section after completion of contact rail installation.

3.13 MANUAL TAMPING

A. No manual tamping shall be performed.

3.14 SPACING AT TIE ENDS

A. Conduit stub-ups, manholes, buried vaults, cableways, foundations, walls, obstructions or other trackway construction shall be at least 12 inches outside of a line created by connecting adjacent tie ends.

B. Additional space shall be provided to ensure 12 inch clearance behind third rail assemblies. Ties or tie layouts shall not be modified to accommodate this requirement.

3.15 TIRE SHRED INSTALLATION

A. Subgrade Preparation: The subgrade that will underlie the tire shred course shall meet the grade tolerance, compaction, and other requirement specified in Section 31 00 00, Earthwork. Install subdrain lines as indicated in Section 33 46 00, Subdrainage.

B. Geotextiles: The tire shred course shall be enclosed in a layer of geotextile as shown on the Contract Drawings. The geotextile shall be unrolled smoothly on the surface to minimize wrinkles and folds. Adjacent lengths of geotextile shall be overlapped a minimum of 18 inches at the ends and sides. The cover material shall be dumped on previously placed cover material or at the edges of the geotextile, and then pushed on to the geotextile. Construction equipment shall not be allowed on the geotextile when the geotextile is covered with less than eight inches of compacted cover material.

C. Placing: The tire shred layer shall be placed in two lifts of approximately equal thickness. Each lift of tire shreds shall be placed over the full width of the section. The tire shreds shall be spread with equipment as needed to obtain a uniform lift thickness. The tire shreds, as spread, shall be well mixed with no pockets of either fine or coarse tire shreds. Segregation of large or fine particles will not be allowed.

D. Shaping and Compacting: Each lift of tire shreds shall be compacted with six passes of a vibratory smooth drum roller with a minimum static weight of 20,000 lb. The completed surface of the tire shred course shall be brought to a condition of uniform stability, compaction, and texture, ensuring no addition of foreign materials. The top surface of the tire shred fill shall be overbuilt to an elevation one inch above the finished elevation shown on the Contract Drawings. A tolerance of one and a half inches below the required grade and cross section will be allowed.

3.16 FIELD QUALITY CONTROL

A. Contractor Testing: Sample ballast at the time of deposit on the trackbed, and perform a minimum of one gradation test and one test on material finer than No. 200 sieve for every 1,000 cubic yards of ballast delivered to the jobsite to ensure uniformity and conformance with the requirements specified herein. Submit a report of the test results to the Engineer.

B. The Engineer may take additional samples of in-place ballast. The Contractor shall assist and cooperate with the Engineer in taking such samples.

C. Any in-place ballast not meeting the requirements herein shall be replaced by the Contractor at no additional cost to the District.

D. Subballast Field Quality Control:

1. Test the relative compaction of each layer of compacted subballast in accordance with California Test Method No. 216.

2. Perform tests in accordance with ASTM D6938 to determine compliance with specified requirements for density and compaction of subballast, and to determine moisture content of the installed subballast.

END OF SECTION 34 11 27